DOCUMENT RESUME

ED 105 839 IR 001 870

AUTHOR	Frick, Frederick C.
TITLE	Educational Technology Program. Quarterly Technical Summary; 1 December 1974 through 28 February 1975.
INSTITUTION	Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
SPONS AGENCY	Air Force Systems Command, L.G. Hanscom Field, Mass. Electronic Systems Div.
REPORT NO	ESD-TR-75-139
PUB DATE	15 Mar 75
NOTE	13p.
EDRS PRICE	MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS	*Computer Oriented Programs; *Electromechanical Aids; Electronic Equipment; *Input Output Devices; Microfiche; *Microform Readers; Microforms; Microreproduction; Military Organizations; Reprography; *Research Projects
IDENTIFIERS	*Lincoln Terminal System; LTS

ABSTRACT

The development of the Lincoln Terminal System (LTS) terminals is described. During the quarter, a decision was made to discontinue work on a cassette-based microfiche storage and retrieval system and to continue work on a carousel-based system. The center has continued its preparation of lessons for use with LTS. Application of LTS to the maintenance management activities of a mobile communications group is noted. Other work on the LTS hardware included: (1) development of a microfiche reader, (2) development of a microcomputer system for use with the terminals, (3) simplification of the terminal electronics, and (4) improvements in the microfiche photography capabilities of the system. (DGC)

ESD-TR-75-139

ED 058357

Quarterly Technical Summary

Educational Technology Program

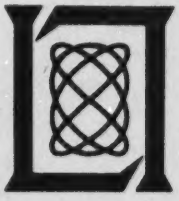
15 March 1975

Prepared for the Department of the Air Force
under Electronic Systems Division Contract F19628-73-C-0002 by

Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LEXINGTON, MASSACHUSETTS



Approved for public release; distribution unlimited.

IR 001 670

The work reported in this document was performed at Lincoln Laboratory, a center for research operated by Massachusetts Institute of Technology, with the support of the Department of the Air Force under Contract F19628-73-C-0002.

This report may be reproduced to satisfy needs of U.S. Government agencies.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

Eugene C. Raabe

Eugene C. Raabe, Lt. Col., USAF
Chief, ESD Lincoln Laboratory Project Office

Non-Lincoln Recipients

PLEASE DO NOT RETURN

Permission is given to destroy this document when it is no longer needed.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LINCOLN LABORATORY

EDUCATIONAL TECHNOLOGY PROGRAM

QUARTERLY TECHNICAL SUMMARY REPORT TO THE AIR FORCE SYSTEMS COMMAND

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

1 DECEMBER 1974 – 28 FEBRUARY 1975

ISSUED 2 APRIL 1975

Approved for public release; distribution unlimited.

LEXINGTON MASSACHUSETTS

ABSTRACT

Work on the cassette terminal has been dropped and development concentrated on an improved carousel-based system to be designated LTS-5. An improved audio reader has been developed, with satisfactory initial performance.

The AFCS project to investigate the use of LTS technology in field maintenance is on schedule, with field operations scheduled to begin early in the next quarter.

CONTENTS

	Abstract	iii
	Organization	vi
I.	Introduction	1
II.	LTS Courseware Development	1
III.	AFCS Maintenance Management System	1
IV.	LTS Hardware Development	2
	A. Fiche Selector	2
	B. Reader Development	3
	C. Second-Generation Self-Processor	3
	D. Terminal Electronics	5
	E. Microfiche Photography	5

ORGANIZATION

EDUCATIONAL TECHNOLOGY PROGRAM

PROGRAM MANAGER

F. C. Frick

DIVISION 2

Technical Staff	Assistants	Technician
Brown, J. R.	Bonder, Z. M.	Ritchie, J. R.
Butman, R. C.	Gagnon, J. V.	
Harris, W. P.	Pugh, Barbara K.	
Kurtze, J.	Rodgers, R. E.	Photographer
Mayer, R.	Saliga, R. J.	
McLaughlin, A. J.		Recke, R. F.
Wiesen, R. A.		

EDUCATIONAL TECHNOLOGY PROGRAM

I. INTRODUCTION

A major change in emphasis in the LTS hardware development program occurred during this quarter with the decision to stay with a carousel-based microfiche selection system and to drop the cassette development effort. This decision was based on a reconsideration of the probable cost and performance of a production system, on the desirability of developing a commercial source of equipment at the earliest possible date, and on experience data obtained with the LTS-3S terminals. The new terminal configuration will be designated LTS-5.

The project with the Air Force Communications Service (AFCS) to explore the use of LTS technology in the support of field maintenance and technical management is on schedule. An LTS-3S terminal has been checked out and delivered to Robins AFB, and the production of microfiche on maintenance procedures for the AN/TRC-97A mobile communications set is nearing completion. In addition, we have obtained from Keesler AFB six modules of related career development material which will be processed for inclusion in the field experiment.

II. LTS COURSEWARE DEVELOPMENT

Work has concentrated in the area of lesson development, under contracts with the U.S. Bureau of Mines and the National Science Foundation.

III. AFCS MAINTENANCE MANAGEMENT SYSTEM

The exact performance and alignment procedures for the TRC-97A were devised with personnel from the 5th Mobile Communications Group. The order in which these procedures are to be performed and what alignments are to be initiated when performance is substandard also were specified. All art work was prepared, and appropriate logic and audio were mapped out.

The procedures were compiled in booklet form and checked out at Robins AFB in the real TRC-97A environment. Various details, cautions, and misunderstandings were acknowledged and the procedures were corrected.

Most of the procedures have been committed to fiche, and the fiche have been run on the LTS-3S. By the end of this reporting period, fiche will have been prepared for the remaining procedures and several introductory and ancillary frames. The entire collection is scheduled to be taken to Robins in the final week of March for operational checkout with the LTS-3S and a TRC-97A maintenance expert.

During this reporting period, four subroutines have been developed for the LTS-3S and incorporated into the read-only space. This necessitated a few changes in the monitor. When the new PROMS are in the terminal, the ability to examine and change RAM from the teletype is no longer available. These functions are not necessary during user operation of the terminal, but reserve PROMs are available for LTS-3S maintenance. The inspect dump routines will be reintroduced later in a modified form.

The four new subroutines provide: (a) a generalized number input from the LTS-3S keyboard and output to the teletype; (b) a means of comparing the relationship between two decimal numbers; and (c) an ability to put a question number to the left of the LED display. The purpose of the latter is to permit the author to show the student which question he is answering, yet keep

the student's answer physically separated from the question number. The other subroutines have more obvious purposes.

Several special programs have been written to deal with frames where the user is to input measurements. While these programs use the above subroutines, their bulk consists of formatting output to the teletype so that the user and his supervisor are able to see what procedures have been employed and what measurements have been entered.

The LTS-3S terminal to be used for field experimentation has successfully completed cycle tests and has been packed and shipped to Robins AFB along with a TTY terminal and the necessary spares. A one-week course on the operation and maintenance of the terminal was conducted during the first week of March for a member of the 5th Mobile Communications Group, AFCS. Preparations have been made to unpack and check out the terminal on-site at Robins during the third week of March.

IV. LTS HARDWARE DEVELOPMENT

It has been concluded that the cassette-based instructional delivery system does not offer distinct advantages in either cost or performance over the carousel-based system. Future work in this area will be directed at configuring a fiche handling system based on selected parts of the carousel-based system and improvements in positioning and control demonstrated in the LTS-3S system. The new reader, based on a Rohlix drive, has been assembled and is undergoing preliminary testing. In addition to being simple in construction, the new reader appears to be more linear than the LTS-3S reader while maintaining approximately the same dynamic range.

A second-generation self-processor system has been designed. This new microprocessor system will accommodate programs written for the first-generation system while providing an expanded program set and increased RAM and PROM capacity. The processor is presently being partitioned into modules which will be the basis for a pilot run of a new set of printed-circuit cards. The combination of the carousel-based fiche selector, reader, and terminal electronics will hereafter be referred to as the LTS-5 system.

A. Fiche Selector

Cycle tests of the cam-driven fiche manipulator and the associated envelope scratch tests have been terminated. It has been concluded that the cassette-oriented system does not offer distinct advantages in cost or performance over a carousel-based fiche selection system. This decision has been based on several factors: The most important consideration is the fact that we now have collected cycle test data over the last year on four LTS-3S stand-alone systems. The test data indicate that the frame access error rate for all causes is approximately 0.2 percent which, in conjunction with a forgiving software system, is considered more than adequate for an automated instructional delivery system. From a cost standpoint, the present carousel system is currently being manufactured in quantity, thus avoiding large start-up costs, and offers a price advantage of .0 percent for quantities of a thousand or more. Since the fiche handling equipment represents less than 30 percent of the total terminal cost, alternatives would have to offer advantages of 2 or 3 to 1 in cost and performance to warrant further investigation on limited funding. The nature of our continued work in this area will be to configure a fiche handling system based on selected parts of the carousel-based system and improvements in positioning and control demonstrated in the LTS-3S system.

B. Reader Development

The new audio reader described in the previous QTS* has been assembled in an LTS-4 bell housing and is presently being checked out. The calculated and measured responses of the spiral tracker servo system are shown in Fig. 1. The good agreement between measured and calculated closed-loop responses is due to the linearity of the electromechanical system which is based on a Rohlix drive. At the present time, the system has a 12-dB gain margin and is successfully

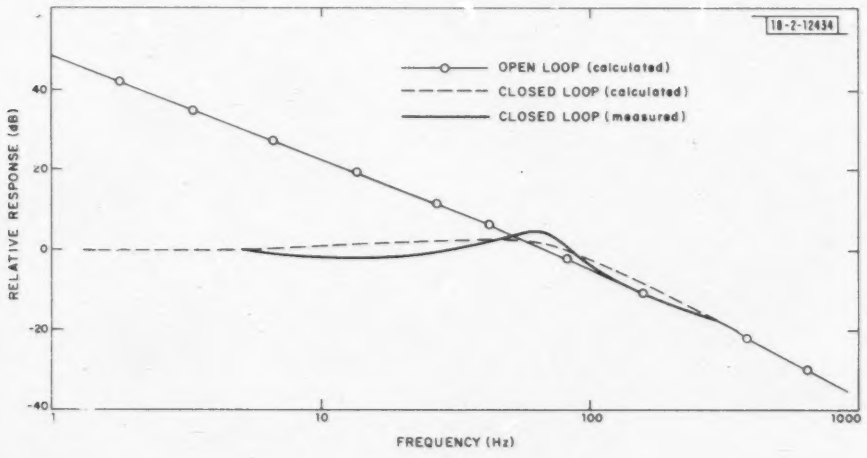


Fig. 1. Spiral tracker response.

acquiring and tracking spirals containing audio and data which are displaced in X-Y from the system optical axis by an amount equivalent to 1.5-percent FM. These results are preliminary, and are based on bench experiments rather than an actual system environment where the tracker must acquire and track a spiral which has been positioned by the fiche selection subsystem. A simple supporting structure is being designed which will permit the reader to be installed in an LTS-3S system and tested under computer control and actual operating conditions.

C. Second-Generation Self-Processor

The present LTS-3S system includes an Intel SIM4-03 microcomputer system in which microprograms are stored on electrically programmable and erasable read-only memories which are, in turn, controlled by a single-chip CPU (4004). The present system is offered by the manufacturer as an interim means for establishing microcomputing capability. For fabrication of a small number of units, the most economical approach appears to be one where Intel RAM, PROM, and CPU chips are assembled on a printed-circuit card designed to suit the needs of the individual user.

Recently, Intel has made available a second-generation hardware set which includes a 4040 CPU chip and series of I/O and decoder chips which will reduce the system integrated-circuit population. The 4004 instruction set is a subset of the 4040 instruction set, and programs generated for the 4004 will operate on the 4040. An additional 14 instructions provide the capability for Halt, Logical Operation, Interrupt, PROM bank switching, and Index Register bank

*Educational Technology Program Quarterly Technical Summary, Lincoln Laboratory, M.I.T. (15 December 1974), p. 3, DDC AD-A005325.

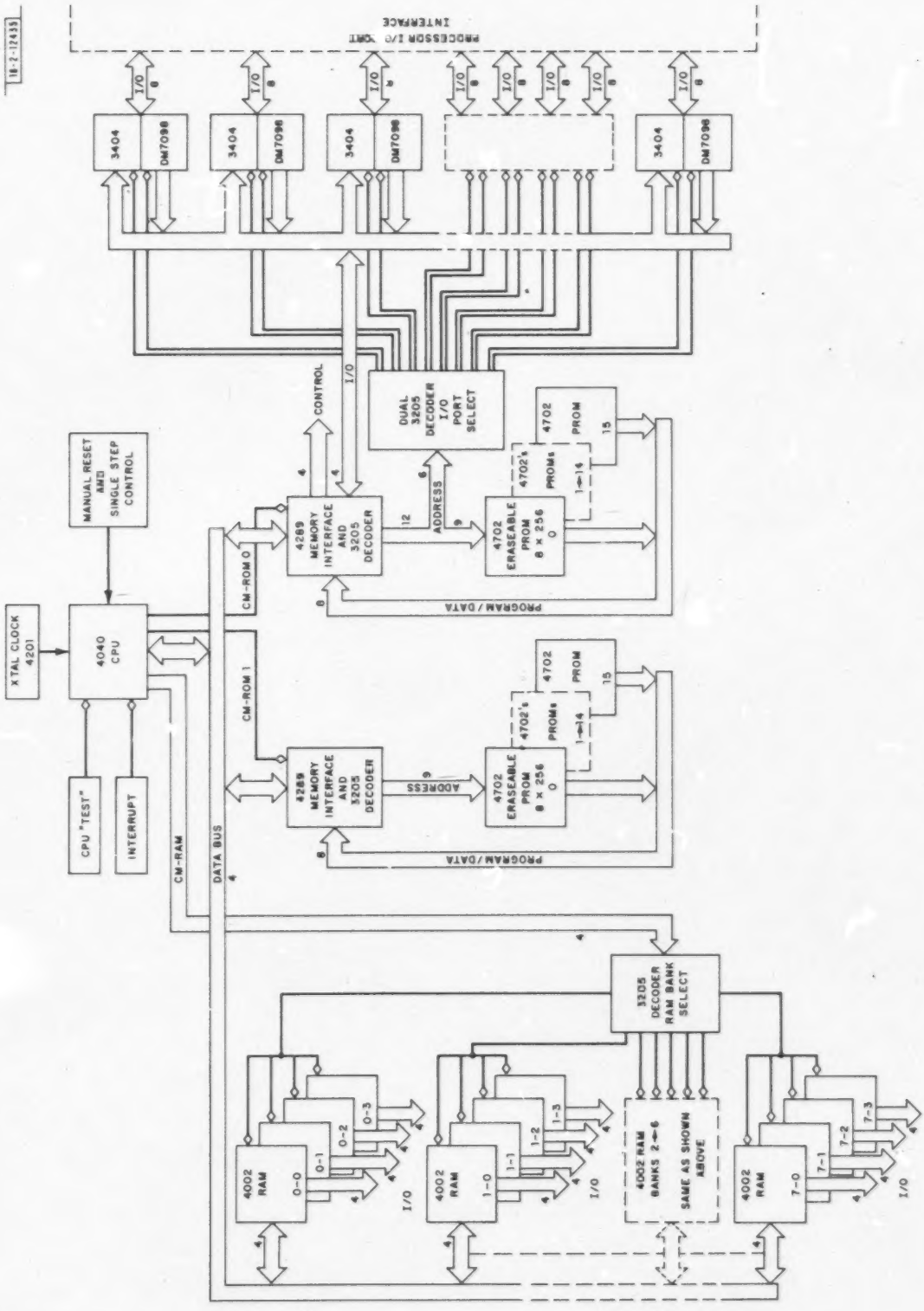


Fig.2. Second-generation self-processor.

switching. The PROM capacity has been expanded from 4 × 8K to 8 × 8K, and the RAM capacity has been expanded to 4 × 2K bits of main memory and 4 × 512 bits of status memory.

A second-generation self-processor has been designed and is shown in Fig. 2. The architecture is based on the second-generation hardware and is organized such that the system can be partitioned in a manner which permits modular expansion of I/O ports within the terminal interface to minimize interconnection complexity. The design of the various processor modules has been initiated and will be implemented on printed-circuit cards in the near future.

D. Terminal Electronics

Some preliminary effort has been directed toward simplifying and minimizing the terminal electronics for the LTS-5. In the original LTS-3 and subsequent LTS-3S systems, some power supplies were duplicated to minimize subsystem noise problems. Recent tests have indicated that with careful decoupling and power distribution techniques, separate power supplies for the +5V and ±15V could be eliminated. In addition, the 6-V fiche selection relays have been replaced with 5-V relays mounted in dual-in-line packages, thus eliminating the need for a +6-V power supply. All current LTS-3S systems will be converted for operation with common power supplies and new +5-V relay cards.

A new printed-circuit card has been designed for use in the LTS-5 system. The 6- × 8-inch card, common to all electronics and based on system IC density predictions, will have an 80-pin wirewrappable I/O connector. The self-processor modules discussed in the previous section will constitute a pilot run for the new cards.

E. Microfiche Photography

In the last quarterly report, the LTS fiche production facility was reviewed. During this quarter, work has continued to optimize procedures and print quality.

A severe problem with resolution and contrast of the Kalvar prints arose during the quarter. An unacceptably large fraction of the 334 prints made was not acceptable. Examination of the raw film showed that much of it was excessively grainy and uneven in texture. A few lots in stock were found to be acceptably clear. A series of exposure tests was made with these acceptable lots to reaffirm our production procedures. As a result of these tests, initial exposure was adjusted downward from 50 to 35 sec, and the fixation temperature was decreased from 260° to 240°F. All film in stock is being replaced; the replacement film will be processed in accordance with the new exposure and temperature schedules.

It has been noted previously that the printer used to make the Kalvar prints is the primary limit to resolution in the reproduction process. In order to compare the performance with another printer, a silver halide master was sent to a vendor who made several comparison prints on a recommended printer. These test prints are of essentially the same quality as those produced in our own facility. Experiments designed principally to reduce internal reflections in our own printer, which could degrade resolution, have produced inconclusive results. We will continue to look for improved printing techniques, although the print quality we are now obtaining – with improved film and control at each step of the reproduction process – is quite satisfactory.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ESD-TR-75-139	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Educational Technology Program		5. TYPE OF REPORT & PERIOD COVERED Quarterly Technical Summary 1 December 1974 – 28 February 1975
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Frick, Frederick C.		8. CONTRACT OR GRANT NUMBER(s) F19628-73-C-0002
9. PERFORMING ORGANIZATION NAME AND ADDRESS Lincoln Laboratory, M.I.T. P.O. Box 73 Lexington, MA 02173		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Project No. 649L
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Systems Command, USAF Andrews AFB Washington, DC 20331		12. REPORT DATE 15 March 1975
		13. NUMBER OF PAGES 12
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)* Electronic Systems Division Hanscom AFB Bedford, MA 01731		15. SECURITY CLASS. *(of this report)* Unclassified
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

None

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

educational technology
Lincoln Terminal System (LTS)
Lincoln Terminal Language (LTL)
microfiche production
computer-aided instruction (CAI)

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Work on the cassette terminal has been dropped and development concentrated on an improved carousel-based system to be designated LTS-5. An improved audio reader has been developed, with satisfactory initial performance.

The AFCS project to investigate the use of LTS technology in field maintenance is on schedule, with field operations scheduled to begin early in the next quarter.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*